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ABSTRACT

This study sought to infer dimensions of scientific literacy with regard to a theoretical definition for a group of science-oriented persons, for a group of nonscience-oriented persons, and for the two groups combined. Relationships between the inferred dimensions and the predictor variables, educational level, amount of science education, educational level of parents, age, and sex were investigated. A theoretical definition of scientific literacy was developed and used to develop a 45-statement Q-set. The randomly selected groups consisted of 75 university and 100 public science persons, and 75 university and 100 public nonscience persons. Participants were asked to sort the Q-set in terms of "What should be expected of most high school graduates with regard to science?" Descriptive statistics, correlations, factor analysis, analyses of variance, and regression analysis were used to analyze the data. Seven inferred dimensions of scientific literacy were developed: scientific inquiry, maintaining current awareness, valuing methods of science, personal application of science, distinguishing between science and technology, utilizing factual knowledge, and mutual involvement of science and society. (Author/MH)

PERCEPTIONS OF SCIENTIFIC LITERACY

Lawrence L. Gabel, Ph.D.*

RATIONALE AND OBJECTIVES

Fundamental determinants of educational directions have been thought to be economic, political, social, and religious in nature. Recently science and technology have been considered additional determining forces because of their interplay with the traditional forces.(1) Currently science serves three purposes in the schools' curricula:

1. to prepare future scholars for the different disciplines of science;
2. to help individuals attain necessary backgrounds for entry into technological occupations and professions; and
3. to provide an aspect of individuals' general education which will promote effective citizenship.(2,3)

The study reported herewith focused upon the latter purpose. Often the umbrella term "scientific literacy" is used in connection with a statement of this nature. Generally scientific literacy is taken to mean that all people should be broadly educated in science including its products, processes, philosophy, and impact upon society.(4) However, persons using the term often fail to give it adequate meaning; they assume everyone understands it.(5)

Research in science education has been criticized for not having a theoretical base -- a propositional framework. This has in effect left the results of research without meaning and left researchers with little notion of the actual state of knowledge.(6,7,8) Thus it is not surprising that an acceptable system for assessing levels of achievement in scientific literacy has not been developed.(9) On a broader scale it is not surprising that the public's appreciation of science and its interrelationships with technology and society are not well understood.(10)

This study sought to infer dimensions of scientific literacy with regard to a theoretical definition for a group of science oriented persons, for a group of non-science oriented persons, and for the two groups combined. It sought to compare the strength of agreement of the two orientation groups, and of subgroups of the two groups, on the inferred dimensions. Finally, it sought to investigate relationships between the inferred dimensions and persons' sex, age, educational level, amount of science education, and parents' educational level.

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THEORETICAL DEFINITION OF SCIENTIFIC LITERACY

The development of a theoretical definition of scientific literacy was begun by searching science education journals; appropriate dissertations; and the data base of the Science, Mathematics, and Environmental Education Clearinghouse of the Educational Resources Information Center for statements describing scientific literacy. Most statements were couched in terms of behaviors to be expected of scientifically literate persons. It was decided that a meaningful theoretical definition of scientific literacy could be constructed if a two way matrix was employed -- dimensions of scientific literacy versus taxonomies of educational objectives.[11,12] Thus, the Theoretical Model of Scientific Literacy (TMSL) became the theoretical definition for this study (Appendix A).

Each TMSL element describes a behavior to be expected of a scientifically literate person and has both a dimensional characteristic and a major class characteristic. These elements were developed to capture the essence of the many statements found in the literature. Sixteen (16) cells were initially empty because appropriate statements were not found; elements were written to fill these cells.

INSTRUMENTATION

Q-sort technique was chosen as the means to collect data for the purpose of inferring dimensions of scientific literacy for the various groups of persons. Q-sort technique involves sorting a set of objects, a Q-set, into piles which represent a continuum from that which is most valued to that which is least valued. When a structured Q-set (one which embodies a theory) is sorted, it allows for the study of that theory. The sorting of the Q-objects by persons yields a representation of their attitudes toward the theory under investigation.[13]

The Scientific Literacy Q-set (SLQ) was developed to represent the theoretical definition of scientific literacy used in the study, the TMSL (Appendix B). Results from piloting prototype SLQ's led to four conditions:

1. Forty-five (45) randomly selected TMSL elements would be represented in the SLQ.
2. Five (5) cells from each major class would be selected.
3. One (1) element from each cell would be selected.
4. The three (3) Dimension I components would be treated as though each was a dimension.

The sorting instructions (Appendix C) asked persons to sort the Q-statements into nine piles, five cards per pile, in terms of "What should be expected of most high school graduates with regard to science?". The piles represented a continuum from MOST IMPORTANT (+4) to LEAST IMPORTANT (-4). To gain knowledge about the persons the INFORMATION SHEET (Appendix D) was developed to collect data concerning:

1. educational level;
2. amount of science education;
3. parents' educational level;

4. age; and
5. sex.

Two additional pilot studies were conducted. A check on readability was made with twenty-four (24) junior high students. The joint usability of instruments and instructions was checked with twelve (12) adults who were representative of the major study sample.

Thirty-eight (38) additional adults were asked to sort the SLQ in a test-retest situation over a range of one (1) to eight (8) weeks. Using Pearson's $\underline{r}$ an average correlation coefficient of 0.497, each Q-statement with itself, was attained. This value was accepted as an estimate of the SLQ reliability. Five (5) Q-statements -- Q8, Q10, Q20, Q37, and Q42 -- did not correlate significantly, $\underline{p} \leq 0.05$.

POPULATION SAMPLE

Science oriented persons were defined as persons whose occupations required training in a science or science-related field. Non-science oriented persons were those whose occupations required no such training. Persons were drawn from two (2) sources, the faculty at The Ohio State University and residents of Franklin County, Ohio. Figure A indicates the number of persons by type which were drawn.

	Science Oriented	Non-Science Oriented
University	75 persons (UNVSC)*	75 persons (UNVNONSC)
Public	100 persons (PUBSC)	100 persons (PUBNONSC)

*Identifying label for type of person

FIGURE A

Sampling Frame For Study

The UNVSC and UNVNONSC persons were drawn randomly from The Ohio State University 1975-76 Faculty/Staff Directory. Not only was the directory partitioned according to Figure A, but the UNVSC persons were subdivided as to pure or applied science orientation. Thirty-seven (37) pure science (UNVPURSC) and thirty-eight (38) applied science (UNVAPPSC) persons comprised the UNVSC group. The public persons were drawn randomly from the R.L. Polk Directory (14). This listed persons alphabetically and provided their occupations, employers, and home addresses. After the necessary number of PUBSC and PUBNONSC persons was drawn, the Ohio Bell Telephone facilities were used to ascertain the status of the persons. The process was repeated to replace persons who were no longer county residents.

DATA COLLECTION

The SLQ, INFORMATION SHEET, and ancillary materials were mailed to the 350 persons on April 4, 1976. On May 14, 1976, the data collection period was concluded; 185 persons had responded. It was determined that forty (40) persons did not receive the materials; therefore, there was a 60% response. Statistical tests indicated that respondents in the five (5) subgroups were representative of the original subgroups.

RESULTS

Table 1 indicates respondents as a whole (OVERALL) tended to rate knowledge, comprehension, and application behaviors more highly than other behaviors. They were supportive of most Q-statements in the Factual and Generalizations components of Dimension I and those in Dimensions II and VIII. They played down the importance of Q-statements in the Discipline component of Dimension I and those in Dimensions III and V. They had mixed feelings about Q-statements in other dimensions depending upon the particular behaviors involved.

Individual subgroups of respondents tended to place more importance on knowledge and comprehension behaviors than on the others. The UNVNONSC, PUBSC, and PUBNONSC subgroups tended to rate the application behavior more highly than did the UNVPURSC and UNVAPPSC subgroups. All subgroups tended to be less favorable toward synthesis, evaluation, valuing, and behaving. The UNVAPPSC subgroup tended to be more supportive of the advocating behavior than were other subgroups.

Appropriate Q-statement data were factor analyzed for the SCIENCE respondents, for the NONSCIENCE respondents, and for all respondents grouped together, OVERALL. Orthogonal, principal component solutions were developed; diagonal elements of the correlation matrix were replaced iteratively by R^2 estimates of communality. A seven (7) factor solution was developed for each group. By examining the information gleaned from the factor analyses, the factors were described and named thus becoming the inferred dimensions of scientific literacy. Table 2 summarizes the factor analysis work and the inferred dimensions.

Factors I, III, IV, V, and VI were common to the OVERALL, SCIENCE, and NONSCIENCE groups while Factor II was common to the OVERALL and NON-SCIENCE groups. Only one (1) OVERALL factor, Factor VII, was not specifically found in either of the SCIENCE or NONSCIENCE factor solutions. However, since the OVERALL group is actually a combination of the SCIENCE and NONSCIENCE groups, all seven (7) OVERALL factors existed to some extent within the factor solutions of the SCIENCE and NONSCIENCE groups. Upon this basis the comparison of strength of agreement of the two orientation groups, and of subgroups of the two groups, on each of the inferred dimensions was made.

TABLE 1

Means and Standard Deviations for Responses to Q-Statements

Q-Statement	Behavior	UNVPURSC (N=21)		UNVAPPSC (N=19)		UNVNONSC (N=40)		PUBSC (N=52)		PUBNONSC (N=42)		OVERALL[c] (N=175)[d]	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
IA11[a] (28)[b]	Knowledge	.9	3.2	3.0	1.3	1.0	2.9	1.6	2.4	1.4	2.2	1.5	2.6
IA31 (45)	Application	.3	2.8	.9	2.6	1.1	2.2	1.1	2.6	1.2	2.4	1.0	2.5
IA41 (42)	Analysis	-.6	2.7	-.2	2.4	.6	2.4	-.1	2.3	.1	2.4	0.0	2.4
IA51 (39)	Synthesis	-.3	2.5	.9	2.5	.2	2.5	1.3	2.1	1.0	2.3	.7	2.4
IA61 (21)	Evaluation	.9	2.2	.3	2.3	.1	2.2	.1	2.3	.8	2.4	.7	2.3
IA223 (44)	Comprehension	.8	2.4	.6	2.2	-.2	2.5	.2	2.5	.3	2.5	.2	2.4
IA32 (19)	Application	.5	2.6	.9	2.3	1.1	2.2	1.2	2.3	.8	2.7	1.0	2.4
IA52 (27)	Synthesis	-1.0	2.2	.6	2.3	.6	2.0	.9	2.2	.5	2.4	.5	2.3
IA62 (23)	Evaluation	-.1	2.0	.7	2.3	.2	2.3	.6	2.1	-.5	2.3	.2	2.2
IB12 (13)	Valuing	-1.2	2.7	-1.6	2.0	-.1	2.9	-2.0	2.4	-2.1	2.3	-1.4	2.6
IA13 (41)	Knowledge	2.1	2.0	1.4	2.5	1.9	2.1	.9	2.2	1.5	2.4	1.5	2.3
IA53 (25)	Synthesis	-3.0	1.5	-1.6	2.5	-2.0	2.1	-1.0	2.5	-1.5	2.1	-1.7	2.3
IB231 (29)	Behaving	-.7	2.5	-1.4	2.0	0.0	2.4	-.1	2.4	0.0	2.6	-.2	2.4
IB33 (34)	Advocating	.4	2.3	.4	2.0	0.0	2.3	-.5	2.2	-.2	2.1	-.1	2.2
IIA41 (7)	Analysis	1.5	2.2	.7	2.3	1.4	2.4	1.5	2.2	1.5	2.1	1.4	2.2
IIB11 (2)	Valuing	2.5	2.0	.8	2.6	1.2	2.6	1.4	2.4	1.7	2.2	1.5	2.4
IIB21 (8)	Behaving	-.3	2.7	-2.6	2.0	-1.5	2.3	-1.2	2.1	-1.3	2.5	-1.3	2.4
IIB31 (15)	Advocating	1.2	2.5	1.5	2.0	-.2	2.5	.6	2.3	.5	2.3	.6	2.4
IIIA11(12)	Knowledge	.6	2.2	-.8	2.2	.9	2.4	-1.6	2.1	-.4	2.5	-.4	2.5
IIIA21(32)	Comprehension	.8	1.9	-.5	2.3	-.2	2.4	-1.3	2.2	-.8	2.4	-.6	2.3
IIIA51(24)	Synthesis	-1.4	1.7	-1.8	1.8	-.8	2.3	-1.8	2.0	-1.7	2.0	-1.5	2.0
IIIA61(10)	Evaluation	-.7	2.2	-1.0	2.3	-1.0	2.1	-.1	2.1	-.7	2.6	-.6	2.2
IIIB11(6)	Valuing	.7	2.6	-1.5	2.3	-.8	2.5	-.8	2.0	-1.2	2.2	-.8	2.4
IVA11 (37)	Knowledge	-.3	2.4	-.3	2.4	.9	2.2	1.1	2.2	.5	2.1	.6	2.2
IVA214(3)	Comprehension	.6	2.3	-.2	2.5	-.3	2.2	-.2	2.3	-.3	2.3	-.2	2.3
IVA31 (38)	Application	.1	3.1	-.4	3.0	.2	2.4	1.4	2.4	1.0	2.4	.7	2.6
IVA41 (20)	Analysis	0.0	2.4	-.4	2.3	-.6	2.0	-.6	2.1	-.9	2.2	-.6	2.2
IVA51 (40)	Synthesis	-1.7	2.1	-.6	2.7	-.4	2.5	.2	2.4	-.2	2.6	-.4	2.5
VA41 (30)	Analysis	.2	2.2	-.6	2.8	-.4	2.5	-1.5	2.3	-2.0	1.9	-1.0	2.4
VB11 (1)	Valuing	-.8	2.3	-.7	2.2	-1.4	2.0	-.8	2.9	-1.2	2.6	-1.0	2.5
VB21 (35)	Behaving	-.7	2.6	-.8	2.8	-1.6	2.8	-1.7	2.7	-.7	2.9	-1.2	2.8
VB31 (33)	Advocating	.3	2.7	1.6	2.1	-.2	2.7	-.6	2.8	-.4	2.6	-.1	2.7
VIA111(22)	Knowledge	1.7	2.8	0.0	2.4	.4	2.4	-.3	2.3	-.3	2.5	.1	2.5
VIA21 (43)	Comprehension	1.3	1.9	1.2	2.3	.5	2.8	.6	2.6	1.2	2.2	.9	2.5
VIA31 (18)	Application	-.2	2.7	.4	2.5	-.1	2.9	.7	2.9	.3	2.8	.3	2.8
VIA41 (31)	Analysis	-.1	2.6	-.2	2.0	-.8	2.2	-1.3	1.9	-.8	2.0	-.8	2.1
VIA61 (26)	Evaluation	-1.8	1.8	-.5	2.8	-1.0	2.4	-.6	2.6	-1.4	2.2	-1.0	2.4
VIIA21(4)	Comprehension	2.4	1.9	2.8	1.7	2.8	1.7	2.3	2.2	2.5	1.9	2.5	1.9
VIIA61(11)	Evaluation	.9	2.2	.5	2.8	1.1	2.6	.7	2.7	.6	2.6	.8	2.6
VIIB21(17)	Behaving	-1.0	2.1	-1.5	2.4	-1.1	2.6	-.4	2.3	-.4	2.5	-.8	2.4
VIIB31(5)	Advocating	.8	2.5	0.0	2.4	.4	2.6	-1.2	2.2	.6	2.5	-.3	2.5
VIIIA31(9)	Application	-1.1	2.1	-1.3	2.6	.5	2.4	.8	2.5	.7	2.3	.3	2.5
VIIIB11(26)	Valuing	.9	2.3	.7	2.7	.1	2.4	.9	2.5	1.4	2.7	.8	2.5
VIIIB21(14)	Behaving	1.3	2.6	.8	2.9	.3	3.0	.1	3.0	-.5	2.8	.2	2.9
VIIIB31(36)	Advocating	-1.8	2.4	-.2	2.4	-.2	2.7	-1.2	2.2	.5	2.2	-.5	2.4

[a]TMSL element identification
[b]Q-statement number
[c]All subgroups combined
[d]Ten respondents filled out the questionnaire only

TABLE 2

FACTOR LOADINGS OF Q-STATEMENTS CHOSEN TO REPRESENT EACH FACTOR AND EACH RESPECTIVE INFERRED DIMENSION OF SCIENTIFIC LITERACY

Factor	Q-Statement	OVERALL	SCIENCE[a]	NONSCIENCE	Inferred Dimension	Description
	IVA51 (40)	.71	.65	.70	Scientific Inquiry	producing new knowledge
	IVA11 (37)	.60	.54	.66		through a synthesizing
I	IA53 (25)	.56	.43	.39		activity
	IA51 (39)	.40	.49	.32		
	% of variance	9.1	7.5	6.2		
	VIIIB11(16)	.50		.54	Maintaining Current	valuing people keeping
	IIIA11 (12)	-.42		-.57	Awareness	abreast of new developments
II	IIIA21 (32)	-.47		-.42		in science and technology
	IB33 (34)	.39		.54		
	% of variance	6.8		5.1		
	IIIB11 (6)	.53	.67	.45	Valuing Methods of	valuing methods which
III	VIA61 (26)	-.42	-.31	-.47	Science	scientists use in their
	% of variance	5.6	5.4	6.7		work
	IVA31 (38)	.60	.45	.44	Personal Application	applying scientific know-
IV	IA32 (19)	.50	.37	.35	of Science	ledge and methods of science
	VIIIA31(9)	.36	.43	.63		in daily lives
	% of variance	5.2	10.4	8.7		
	VIA41 (31)	.53	.33	.55	Distinguishing	making the distinction in
V	VIAIII (22)	.52	.41	.51	Between Science and	terms of goals and results,
	VIA21 (43)	.47	.59	.56	Technology	also understanding how
	% of variance	4.7	4.4	7.8		science and technology affect each other
VI	IAII (28)	.63	.51	.46	Utilizing Factual	knowing and using factual
	% of variance	4.5	6.2	4.6	Knowledge	knowledge about nature
	VIIIB31(36)	.48			Mutual Involvement	science providing mankind
VII	VIIB31 (5)	.46			of Science and	with new capabilities, also
	IA61 (21)	-.43			Society	society providing supportive
	% of variance	3.9				conditions for science
	VIIIB21(14)		.69		Science As A Human	playing down the "omnipo-
	IB33 (34)		-.45		Endeavor	tency" of science, technology,
	VB21 (35)		.42			and scientists
	% of variance		4.1			
	IA62 (23)			.61	Using Natural	using knowledge to judge
	IA61 (21)			.56	Resources	decisions which are made
	% of variance			4.4		with regard to utilization
						and control of aspects of
	Overall % of variance explained	39.7	43.8	43.6		nature

[a]A noninterpretable factor is not shown.

Comparisons were made using one way analysis of variance. Factor scores were developed for each respondent on each factor of the seven (7) OVERALL factors. Factor scores for a given factor were treated as values of a dependent variable representing that factor. Analysis was between groups whether they were the two orientation groups, SCIENCE and NON-SCIENCE, or subgroups of these two groups. Null hypotheses were posited as:

> Null Hypothesis 1 (a) There are no significant differences in the factor scores of the science oriented group of persons and the nonscience oriented group of persons on each of the inferred dimensions of scientific literacy.
>
> Null Hypothesis 1 (b) There are no significant differences in the factor scores of the subgroups (UNVPURSC, UNVAPPSC, UNVNONSC, PUBSC, PUBNONSC) of the two orientation groups of persons on each of the inferred dimensions of scientific literacy.

Table 3 summarizes the results of the analyses. When a significant F-ratio ($p \leq 0.05$) was encountered, Scheffe' post hoc tests were performed.

TABLE 3

Summary of the Tests of Null Hypotheses 1 (a) and (b)

Factor	Inferred Dimension	Null Hypothesis 1 (a)[a]	Null Hypothesis 1 (b)[b]
I	Scientific Inquiry	not rejected	rejected UNVPURSC < PUBSC[c]
II	Maintaining Current Awareness	not rejected	rejected nonseparable
III	Valuing Methods of Science	not rejected	rejected UNVAPPSC and PUBSC < UNVPURSC
IV	Personal Application of Science	not rejected	rejected nonseparable
V	Distinguishing Between Science and Technology	not rejected	rejected nonseparable
VI	Utilizing Factual Knowledge	not rejected	not rejected
VII	Mutual Involvement of Science and Society	rejected SCIENCE > NONSCIENCE[c]	rejected UNVNONSC < PUBSC

[a] df: 1, 173; $p \leq 0.05$

[b] df: 4, 170; $p \leq 0.05$

[c] Scheffe' results, $p \leq 0.10$

Regression analysis was used to investigate the relationships between the inferred dimensions and biographical variables. A second null hypothesis was posited:

> Null Hypothesis 2 There are no significant predictors or combinations of predictors among the variables: (a) amount of previous education; (b) amount of previous science education; (c) amount of previous education of parents; (d) age; and (e) sex of the persons in the science oriented and nonscience oriented groups of persons and the inferred dimensions of scientific literacy.

Again treating factor scores on each of the seven (7) OVERALL factors as values of seven (7) respective dependent variables, the regression analysis was performed separately for the OVERALL, SCIENCE, and NONSCIENCE groups. Table 4 summarizes the results.

TABLE 4

Summary of the Test of Null Hypothesis 2

Factor	Inferred Dimension	OVERALL	SCIENCE	NONSCIENCE
I	Scientific Inquiry	not rejected[a]	rejected[a]	not rejected[a]
II	Maintaining Current Awareness	rejected	rejected	rejected
III	Valuing Methods of Science	not rejected	rejected	not rejected
IV	Personal Application of Science	rejected	rejected	rejected
V	Distinguishing Between Science and Technology	not rejected	rejected	rejected
VI	Utilizing Factual Knowledge	not rejected	not rejected	rejected
VII	Mutual Involvement of Science and Society	rejected	rejected	rejected

[a] $p \leq 0.05$ for the F-ratio

DISCUSSION

Membership in subgroups of the SCIENCE and NONSCIENCE groups was more related to respondents' perceptions of scientific literacy than was membership in either the SCIENCE or NONSCIENCE group. UNVPURSC respondents seemed to value most high school graduates valuing methods of science and being able to distinguish between science and technology; respondents from more traditional physical science disciplines (physics, chemistry) seemed to value to a lesser extent the personal involvement of most high school graduates with science than did respondents from other science disciplines (earth sciences, life sciences). UNVAPPSC respondents seemed to value most high school graduates knowing and using factual scientific knowledge more so than becoming personally involved with science. PUBSC respondents seemed to value most high school graduates being personally involved with science in their daily lives and maintaining a current awareness of new developments in science and technology more so than being able to distinguish between science and technology.

UNVNONSC respondents seemed to place less value both on maintaining a current awareness of new developments in science and technology and on mutual involvement of science and society than did other subgroups. PUBNONSC respondents seemed to value most high school graduates maintaining a current awareness of new developments in science and technology and knowing and using factual knowledge.

An inverse relationship seemed to exist between respondents' general level of education, as indicated by the last year of school completed, and their valuing of the inferred dimensions of scientific literacy for most high school graduates. Age and sex of respondents per se were weakly related to their perceptions of scientific literacy. PUBSC AND PUBNONSC respondents who had completed fewer years of school and whose parents had completed fewer years of school tended to value more practical aspects of the inferred dimensions of scientific literacy. PUBNONSC respondents who had taken high school courses in general science, earth science, chemistry, or physics seemed to value most high school graduates keeping abreast of new developments in science and technology and applying science in their daily lives.

CONCLUSION

The "laymen's" perceptions of scientific literacy appeared to be fairly pragmatic. A different sample of persons, possibly a younger sample more influenced by the ABC curricula, might have different perceptions. An SLQ developed from the other half of the TMSL might also yield different results. Further research might illuminate these possibilities.

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A THEORETICAL MODEL OF SCIENTIFIC LITERACY

Taxonomies of Educational Objectives

Dimensions of Scientific Literacy		A. Major Classes of the Cognitive Domain			
		A.1 Knowledge Knowledge is demonstrated by scientifically literate persons through those behaviors which emphasize remembering, either by recognition or recall. Knowledge in the field of science can be in the form of: (1) specifics; (2) ways and means of dealing with specifics; and (3) generalizations and abstractions.	A.2 Comprehension Comprehension is demonstrated by scientifically literate persons if, when confronted with a communication, they know what is being communicated and are capable of making some use of that which is contained within the communication. "Communication" is defined very generally; it can be in oral, written, or concrete form.	A.3 Application Application is demonstrated by scientifically literate persons if, when faced with a problematic situation, they can apply appropriate abstractions to seek a solution. There must be no external prompting as to which abstractions to apply or how to apply them.	A.4 Analysis Analysis is demonstrated by scientifically literate persons if, when presented with "material," they can break it into constituent parts and can detect the relationships of the parts or the way in which the parts are organized.
I. The Organization of Knowledge Dimension	1.0 Factual Component	I.A.1.1 Scientifically literate persons should know several facts about the three, separate, and identifiable entities in the universe--matter, energy, and life.	I.A.2.1 Scientifically literate persons should understand several relationships between the fundamental entities--matter, energy, and life.	I.A.3.1 Scientifically literate persons should be able to use their understanding of factual knowledge about nature to explain, to predict, or to control natural phenomena.	I.A.4.1 Scientifically literate persons should be able to discern how factual knowledge developed by the scientific community is probable rather than absolute.
	2.0 Generalizations Component	I.A.1.2 Scientifically literate persons should know several major generalizations in some of the principal fields of science.	I.A.2.2.1 Scientifically literate persons should understand several major generalizations in some of the principal fields of science. I.A.2.2.2 Scientifically literate persons should understand that the product of science is a body of knowledge about the universe, ranging from individual observations to major generalizations. I.A.2.2.3 Scientifically literate persons should understand that as facts are increased through research scientific generalizations often become fewer, clearer, and easier to understand.	I.A.3.2 Scientifically literate persons should be able to use several appropriate scientific generalizations while interacting with the environment.	I.A.4.2.1 Scientifically literate persons should be able to discern how scientific generalizations can have static and dynamic qualities. I.A.4.2.2 Scientifically literate persons should be able to discern some differences between theoretical and empirical generalizations.
	3.0 Discipline Component	I.A.1.3 Scientifically literate persons should know something about developments in some of the principal fields of science.	I.A.2.3 Scientifically literate persons should understand several news media reports of new discoveries and advances in some of the principal fields of science.	I.A.3.3 Scientifically literate persons should be able to use reports of new developments in some of the principal fields of science while interacting with the environment.	I.A.4.3 Scientifically literate persons should be able to discern which fields of science to associate with several of the new developments reported by the news media.
II. The Intellectual Processes Dimension		II.A.1.1 Scientifically literate persons should know some characteristics of several processes of science.	II.A.2.1 Scientifically literate persons should understand how several processes of science are applied.	II.A.3.1 Scientifically literate persons should be able to use several processes of science to solve problems.	II.A.4.1 Scientifically literate persons should be able to discern when and how to apply several processes of science for the solution of a particular problem.

: Underlined items are represented in the Scientific Literacy Q-set.

APPENDIX A (continued)

		B. Major Classes of the Affective Domain		
A.5 Synthesis Synthesis is demonstrated by scientifically literate persons if, when presented with elements common to some phenomenon, they can combine them in such a way as to constitute a pattern or structure not clearly there before. This could be a creative behavior; however, it does not have to be since the behavior can be performed within a given framework.	**A.6 Evaluation** Evaluation is demonstrated by scientifically literate persons if, when presented with a decision-making situation, they can judge the value of ideas, works, solutions, methods, materials, or the like. The judgments may be either quantitative or qualitative and may be made with criteria which are developed internally or externally to the persons.	**B.1 Valuing** Valuing is demonstrated by scientifically literate persons in their willingness to attach worth to some thing, phenomenon, or behavior. The act of valuing something in particular is for the most part a social or educational product which has been slowly internalized by the persons.	**B.2 Behaving** Behaving is demonstrated by scientifically literate persons when they act on or use that which is valued by them. Their actions may extend, may refine, or may deepen their involvement with that which is valued.	**B.3 Advocating** Advocating is demonstrated by scientifically literate persons if they try to convince others of the worth of a particular course of action. This advocacy may be with respect to that which is valued or with respect to a ramification of that which is valued.
I.A.5.1 Scientifically literate persons should be able to combine several facts about matter, energy, and life in order to develop generalizations.	I.A.6.1 Scientifically literate persons should be able to judge the value of the utilization and control of some aspects of nature using their understanding of factual knowledge.	I.B.1.1 Scientifically literate persons should value having an adequate factual knowledge base with regard to matter, energy, and life.	I.B.2.1 Scientifically literate persons should contribute financially to scientific work which attempts to enhance the factual knowledge base about matter, energy, and life.	I.B.3.1 Scientifically literate persons should support Congressional bills which provide expenditures for basic scientific research.
I.A.5.2 Scientifically literate persons should be able to combine several empirical and theoretical generalizations to gain a more complete phenomenological perspective of nature.	I.A.6.2 Scientifically literate persons should be able to judge the value of the utilization and control of some aspects of nature using the their understanding of scientific generalizations.	I.B.1.2 Scientifically literate persons should value generalizations as forms of scientific knowledge which are more powerful than the discrete observations from which they were developed.	I.B.2.2 Scientifically literate persons should define some necessary directions that science should pursue based upon the limitations of empirical and theoretical generalizations.	I.B.3.2 Scientifically literate persons should support the usefulness of scientific generalizations for use in identifying promising means to extend the understanding of natural phenomena.
I.A.5.3 Scientifically literate persons should be able to combine some new developments in a few of the principal fields of science to ascertain potential ramifications.	I.A.6.3 Scientifically literate persons should be able to judge the value of impacts upon their lives by some new developments in a few of the principal fields of science.	I.B.1.3 Scientifically literate persons should value allotting time and expending energy to keep their knowledge of science current.	I.B.2.3.1 Scientifically literate persons should allot time and expend energy to keep in touch with a broad variety of scientific developments. I.B.2.3.2 Scientifically literate persons should allot time and expend energy to keep up with at least one area of science which is of particular interest to them.	I.B.3.3 Scientifically literate persons should support means to narrow the gap between frontier research and the general public's understanding of science.
II.A.5.1 Scientifically literate persons should be able to combine several processes of science to translate their experiences with the environment into knowledge.	II.A.6.1 Scientifically literate persons should be able to judge the value of the utilization and control of some aspects of nature using several processes of science.	II.B.1.1 Scientifically literate persons should value processes of science as modes of inquiry.	II.B.2.1 Scientifically literate persons should display in everyday decision-making a belief in several processes of science.	II.B.3.1 Scientifically literate persons should support knowledge that has been formulated and tested through the use of science processes.

II. The Values and Ethics Dimension	III.A.1.1 Scientifically literate persons should know some characteristics of several values and ethics which underlie science.	III.A.2.1 Scientifically literate persons should understand how several values and ethics underlie science.	III.A.3.1 Scientifically literate persons should be able to use several values and ethics which underlie science while interacting with the environment.	III.A.4.1 Scientifically literate persons should be able to discern how the universal characteristic of science is not affected by particular religions, political beliefs, or geographic locales.
V. The Process of Inquiry Dimension	IV.A.1.1 Scientifically literate persons should know some ways in which the generation of new scientific generalizations depends upon the joint use of processes of science and established scientific generalizatons.	IV.A.2.1.1 Scientifically literate persons should understand that the scientific effort stems from a compelling desire of mankind to understand the environment. IV.A.2.1.2 Scientifically literate persons should understand that a basic characteristic of the scientific effort is a faith in the susceptibility of nature to human ordering and understanding. IV.A.2.1.3 Scientifically literate persons should understand that in the search for knowledge the scientific effort is a dynamic, process-oriented activity. IV.A.2.1.4 Scientifically literate persons should understand that in the scientific effort an attempt is constantly made to simplify and to increase the comprehensiveness of scientific generalizations.	IV.A.3.1 Scientifically literate persons should be able to use jointly some processes of science with their understanding of scientific generalizations while interacting with the environment.	IV.A.4.1 Scientifically literate persons should be able to discern some of the interdependencies between processes of science and derived scientific generalizations.
V. The Human Endeavor Dimension	V.A.1.1 Scientifically literate persons should know some characteristics of science as it exists as a human enterprise.	V.A.2.1 Scientifically literate persons should understand some aspects of science as a man-made structure of human origin.	V.A.3.1 Scientifically literate persons should be able to use some biographical accounts of a scientist's life to develop a perspective of his work.	V.A.4.1 Scientifically literate persons should be able to discern something of what caused scientists to take diverse positions on particular problems which are being studied.
VI. The Interaction of Science and Technology Dimension	VI.A.1.1.1 Scientifically literate persons should know that the primary goal of science is to understand the universe and that the primary goal of technology is to develop utilitarian products. VI.A.1.1.2 Scientifically literate persons should know something about the interrelationships between science and technology.	VI.A.2.1 Scientifically literate persons should understand some aspects of interrelationships between science and technology.	VI.A.3.1 Scientifically literate persons should be able to use their understandings of scientific knowledge to operate useful devices.	VI.A.4.1 Scientifically literate persons should be able to discern products of science from products of technology.
VII. The Interaction of Science and Society Dimension	VII.A.1.1 Scientifically literate persons should know something about interrelationships between science and society.	VII.A.2.1 Scientifically literate persons should understand some aspects of interrelationships between science and society.	VII.A.3.1 Scientifically literate persons should be able to use some social, political, and economic perspectives to understand scientific efforts during a given time period.	VII.A.4.1 Scientifically literate persons should be able to discern some beneficial or harmful impacts that science and society have upon each other.
VIII. The Interaction of Science, Technology, and Society Dimension	VIII.A.1.1 Scientifically literate persons should know something about interrelationships between science, technology, and society.	VIII.A.2.1 Scientifically literate persons should understand some aspects of interrelationships between science, technology, and society.	VIII.A.3.1 Scientifically literate persons should be able to use some recent scientific and technological developments to suggest potential effects on vocational and avocational opportunities within a society.	VIII.A.4.1 Scientifically literate persons should be able to discern how some innovations in science and technology can rearrange political relations through changes in the power and economic balances of the world.

APPENDIX A (continued)

III.A.5.1 Scientifically literate persons should be able to combine several values and ethics which underlie science with values and ethics from other sources.	III.A.6.1 Scientifically literate persons should be able to judge the value of the utilization and control of some aspects of nature using several values and ethics which underlie science.	III.B.1.1 Scientifically literate persons should value for their own lives some of the values and ethics which underlie science.	III.B.2.1.1 Scientifically literate persons should accept as evidence only those observations which have been made with the greatest of care possible and reported with the greatest accuracy feasible. III.B.2.1.2 Scientifically literate persons should reject myths, superstitions, and personal opinions in favor of scientific evidence. III.B.2.1.3 Scientifically literate persons should be open-minded, critical, and skeptical to the degree that they question the validity of even their own conclusions. III.B.2.1.4 Scientifically literate persons should weigh evidence in order to accept or reject conclusions in terms of the data that support them.	III.B.3.1 Scientifically literate persons should support a philosophy which demands that observations and conclusions must be subject to objective criticism, analysis, and review by the entire populace.
IV.A.5.1 Scientifically literate persons should be able to combine some processes of science with their understanding of scientific generalizations to develop generalizations about nature.	IV.A.6.1 Scientifically literate persons should be able to judge the degree of tentativeness of some scientific generalizations knowing that science is not a static accumulation of information.	IV.B.1.1 Scientifically literate persons should value the process of generating new scientific generalizations via an interplay between processes of science and established scientific generalizations.	IV.B.2.1 Scientifically literate persons should display in their everyday decision-making a belief in the interrelated use of processes of science and established scientific generalizations.	IV.B.3.1 Scientifically literate persons should support science as a means by which knowledge can be generated and mankind's understanding of nature can be enhanced.
V.A.5.1 Scientifically literate persons should be able to combine some aspects of scientists' work with some given perspectives of the time periods in which they lived to better understand their work.	V.A.6.1 Scientifically literate persons should be able to judge the morality of scientists' work.	V.B.1.1 Scientifically literate persons should value a scientist's work even though it is later found not to fit within the accepted network of ideas used to explain nature.	V.B.2.1 Scientifically literate persons should accept scientists as people, who like other people are distributed over the whole spectrum of human folly and wisdom.	V.B.3.1 Scientifically literate persons should support efforts to hold scientists responsible for making their work public.
VI.A.5.1 Scientifically literate persons should be able to combine some advancements in science with some prior advancements in technology, and vice versa, to see how each depends upon the other.	VI.A.6.1 Scientifically literate persons should be able to judge the worth of some products of science and some products of technology using appropriate criteria.	VI.B.1.1 Scientifically literate persons should value advancements in science and technology keeping pace with one another.	VI.B.2.1 Scientifically literate persons should display in their political decision-making a belief in equitable financing of both the scientific and technological efforts.	VI.B.3.1 Scientifically literate persons should support the need for an adequate supply of scientific and technological manpower.
VII.A.5.1 Scientifically literate persons should be able to combine several aspects of society with some scientific developments within that society to identify a few interrelationships between science and society.	VII.A.6.1 Scientifically literate persons should be able to judge the wisdom of governmental decisions using their understanding of interrelationships between science and society.	VII.B.1.1 Scientifically literate persons should value viewing the scientific enterprise within the broad perspectives of society.	VII.B.2.1 Scientifically literate persons should develop intelligent opinions concerning the social and moral responsibilities of science.	VII.B.3.1 Scientifically literate persons should support societal conditions within which science can thrive.
VIII.A.5.1 Scientifically literate persons should be able to combine some roles played by science, technology, and society to solve problems faced by mankind to identify some [illegible]ionships between sc[illegible]ogy, and society.	VIII.A.6.1 Scientifically literate persons should be able to judge some potentials and limitations of science and technology for improving human welfare.	VIII.B.1.1 Scientifically literate persons should value societal innovations keeping pace with scientific and technological innovations in order to improve the condition of mankind.	VIII.B.2.1 Scientifically literate persons should guard against science and technology being seen as a cure-all for all of mankind's problems.	VIII.B.3.1 Scientifically literate persons should support the need to change societal values as mankind's ability to regulate the environment increases.

APPENDIX A (continued)

APPENDIX B

The Scientific Literacy Q-Set

MOST HIGH SCHOOL GRADUATES SHOULD... rate highly a scientist's efforts even if his ideas do not fit with those of others. V.B.1.1 — 1	MOST HIGH SCHOOL GRADUATES SHOULD... rate highly for their own use some values which guide scientists in their work. III.B.1.1 — 6	MOST HIGH SCHOOL GRADUATES SHOULD... be able to judge the worth of governmental decisions using their understanding of how science and society affect each other. VII.A.6.1 — 11
MOST HIGH SCHOOL GRADUATES SHOULD... rate highly methods of science as ways to find out things. II.B.1.1 — 2	MOST HIGH SCHOOL GRADUATES SHOULD... be able to detect how to apply some methods of science in their daily lives. II.A.4.1 — 7	MOST HIGH SCHOOL GRADUATES SHOULD... know about several values which guide scientists in their work. III.A.1.1 — 12
MOST HIGH SCHOOL GRADUATES SHOULD... understand that scientists try to make major ideas about matter, energy, and life thorough. IV.A.2.1.4 — 3	MOST HIGH SCHOOL GRADUATES SHOULD... show in daily decisions that they believe in several methods of science. II.B.2.1 — 8	MOST HIGH SCHOOL GRADUATES SHOULD... rate major ideas more highly than facts as means to explain matter, energy, and life. I.B.1.2 — 13
MOST HIGH SCHOOL GRADUATES SHOULD... understand something of the effects science and society have on each other. VII.A.2.1 — 4	MOST HIGH SCHOOL GRADUATES SHOULD... be able to use some new results from science and technology to think of possible changes in their lives. VIII.A.3.1 — 9	MOST HIGH SCHOOL GRADUATES SHOULD... show that they believe science and technology cannot cure all of mankind's problems. VIII.B.2.1 — 14
MOST HIGH SCHOOL GRADUATES SHOULD... support societal conditions which help science. VII.B.3.1 — 5	MOST HIGH SCHOOL GRADUATES SHOULD... be able to judge the worth of some uses of matter, energy, and life using several values which guide scientists in their work. III.A.6.1 — 10	MOST HIGH SCHOOL GRADUATES SHOULD... support knowledge which is gained by use of methods of science. II.B.3.1 — 15

APPENDIX B (continued)

MOST HIGH SCHOOL GRADUATES SHOULD... rate highly the need for society to keep up with science and technology. VIII.B.1.1 — 16	MOST HIGH SCHOOL GRADUATES SHOULD... be able to judge the worth of some uses of matter, energy, and life using facts. I.A.6.1 — 21	MOST HIGH SCHOOL GRADUATES SHOULD... be able to judge the worth of some results from science and from technology with different guidelines. VI.A.6.1 — 26
MOST HIGH SCHOOL GRADUATES SHOULD... show that they have opinions about what should be done through science. VII.B.2.1 — 17	MOST HIGH SCHOOL GRADUATES SHOULD... know something about how the goals of science and technology differ. VI.A.1.1.1 — 22	MOST HIGH SCHOOL GRADUATES SHOULD... be able to combine some major ideas to better understand matter, energy, and life. I.A.5.2 — 27
MOST HIGH SCHOOL GRADUATES SHOULD... be able to use their science knowledge to operate useful devices. VI.A.3.1 — 18	MOST HIGH SCHOOL GRADUATES SHOULD... be able to judge the worth of some uses of matter, energy, and life using major ideas. I.A.6.2 — 23	MOST HIGH SCHOOL GRADUATES SHOULD... know several facts about matter, energy, and life. I.A.1.1 — 28
MOST HIGH SCHOOL GRADUATES SHOULD... be able to use some major ideas about matter, energy, and life in their daily lives. I.A.3.2 — 19	MOST HIGH SCHOOL GRADUATES SHOULD... be able to combine several values which guide scientists in their work with values from other sources. III.A.5.1 — 24	MOST HIGH SCHOOL GRADUATES SHOULD... show desire to keep in touch with new gains in several fields of science. I.B.2.3.1 — 29
MOST HIGH SCHOOL GRADUATES SHOULD... be able to detect some ways that scientists have used major ideas and methods of science together. IV.A.4.1 — 20	MOST HIGH SCHOOL GRADUATES SHOULD... be able to combine some new findings in some fields of science to think of possible offshoots. I.A.5.3 — 25	MOST HIGH SCHOOL GRADUATES SHOULD... be able to detect some reasons why scientists sometimes disagree. V.A.4.1 — 30

APPENDIX B (continued)

MOST HIGH SCHOOL GRADUATES SHOULD... be able to detect some of the differences in the results of science and technology. VI.A.4.1 31	MOST HIGH SCHOOL GRADUATES SHOULD... support changing what society rates highly as mankind increases control of the environment. VIII.B.3.1 36	MOST HIGH SCHOOL GRADUATES SHOULD... know something of what has happened in some fields of science. I.A 1.3 41
MOST HIGH SCHOOL GRADUATES SHOULD... understand how several values guide scientists in their work. III.A.2.1 32	MOST HIGH SCHOOL GRADUATES SHOULD... know something about using major ideas and methods of science together to gain new ideas. IV.A.1.1 37	MOST HIGH SCHOOL GRADUATES SHOULD... be able to detect conditions which can change what is believed to be a fact. I.A.4.1 42
MOST HIGH SCHOOL GRADUATES SHOULD... support the idea that scientists should let their work be checked by others. V.B.3.1 33	MOST HIGH SCHOOL GRADUATES SHOULD... be able to use major ideas and methods of science together in their daily lives. IV.A.3.1 38	MOST HIGH SCHOOL GRADUATES SHOULD... understand something of the effects science and technology have on each other. VI.A 2.1 43
MOST HIGH SCHOOL GRADUATES SHOULD... support ways to help people understand new gains in some fields of science. I.B.3.3 34	MOST HIGH SCHOOL GRADUATES SHOULD... be able to combine facts to better understand matter, energy, and life. I.A.5 1 39	MOST HIGH SCHOOL GRADUATES SHOULD... understand that new facts often simplify major ideas about matter, energy, and life. I.A.2.2.3 44
MOST HIGH SCHOOL GRADUATES SHOULD... show that they accept scientists as people. V.B.2.1 35	MOST HIGH SCHOOL GRADUATES SHOULD... be able to combine some major ideas and methods of science to gain new ideas. IV.A.5.1 40	MOST HIGH SCHOOL GRADUATES SHOULD... be able to use several facts about matter, energy, and life in their daily lives. I.A.3.1 45

INSTRUCTIONS FOR USING THE SMALL CARDS AND SMALL ENVELOPES

To use these cards and envelopes, you will need a flat area like a desk or a table. First, spread the envelopes across the flat area with the envelope marked +4 on the far left and with the envelope marked -4 on the far right. The other envelopes will be spread in the middle. When you are done, your envelopes should be placed as pictured here:

Flat Area

+4	+3	+2	+1	0	-1	-2	-3	-4
MOST IMPORTANT								LEAST IMPORTANT

On each card is a statement. As you follow the instructions, you will be sorting the cards in terms of how important you think each is. The thought to keep in your mind at all times is: "What should be expected of most high school graduates with regard to science?"

Here are some definitions of words used on the cards:
MOST HIGH SCHOOL GRADUATES: nearly all young people who have just graduated from a high school
MATTER: that of which all things are made
LIFE: that which makes an animal or a plant different from matter
ENERGY: that which through some means can affect matter or life
FACTS: the statements that something was done or that something exists
MAJOR IDEAS: that which is the result of combining facts in order to explain something
SCIENCE: the effort to understand matter, energy, and life
FIELDS OF SCIENCE: examples of these are physics, chemistry, biology, and geology
SCIENTIST: a person trained to understand matter, energy, and life
TECHNOLOGY: the use of what is understood about matter, energy, and life to make things
SOCIETY: a group of people who work together to exist
MANKIND: all people in the world
ENVIRONMENT: that which is around or which has an effect on something

DO NOT READ ALL OF THE INSTRUCTIONS NOW. PLEASE FOLLOW THEM ONE STEP AT A TIME.

STEP 1. Read quickly through all of the cards to get a feeling for what they say. You do not have to keep the cards in order.

STEP 2. Sort the cards into three (3) nearly equal piles so that:
(a) those cards on your left are the cards which you believe are MOST IMPORTANT;
(b) those cards on your right are the cards which you believe are LEAST IMPORTANT; and
(c) those cards in the middle are the cards which you do not feel so strongly about.
Dividing the cards this way means only that you like some cards more than you do others.

STEP 3. Spread the cards in the left-hand pile so that you can read them easily. Choose five (5) cards which you believe are the MOST IMPORTANT of all and place them on the +4 envelope.

STEP 4. Spread the cards in the right-hand pile so that you can read them easily. Choose five (5) cards which you believe are the LEAST IMPORTANT of all and place them on the -4 envelope.

STEP 5. Go to the left-hand pile and choose five (5) cards which are the next MOST IMPORTANT. Place them on the +3 envelope.

STEP 6. Go to the right-hand pile and choose five (5) cards which are the next LEAST IMPORTANT. Place them on the -3 envelope.

Note: IF AT ANY TIME YOU CHANGE YOUR MIND ABOUT A CARD YOU HAVE PLACED IN A PILE, FEEL FREE TO CHANGE IT TO ANOTHER PILE.

STEP 7. Go to the left-hand pile and choose five (5) cards to place on the +2 envelope. You may have to take cards from the middle pile in order to have enough.

STEP 8. Go to the right-hand pile and choose five (5) cards to place on the -2 envelope. You may have to take cards from the middle pile in order to have enough.

STEP 9. Go to the left-hand pile and choose five (5) cards to place on the +1 envelope. Again it is alright to take cards from the middle pile.

STEP 10. Go to the right-hand pile and choose five (5) cards to place on the -1 envelope. Again it is alright to take cards from the middle pile.

STEP 11. You should now have five (5) cards left over. Place these on the envelope marked 0.

STEP 12. Read back over each pile, starting on the left-hand side, to make sure that you have placed the cards where you really wanted them. If you change any of the cards around, please make sure there are five (5) cards in each pile when you finish.

STEP 13. Please place the cards in their envelopes; for example, the five (5) MOST IMPORTANT cards go in the +4 envelope. Please fold the flaps in to hold the cards in place.

STEP 14. Please place the small envelopes and the INFORMATION SHEET into the stamped, return envelope and mail it immediately.

THANK YOU AGAIN FOR YOUR COOPERATION

APPENDIX D

INFORMATION SHEET

A. Please check: (1) ____ female; (2) ____ male

B. Circle the number in front of the choice which includes your age.

(1) 18 - 25 years	(3) 36 - 44 years	(5) 55 - 65 years
(2) 26 - 35 years	(4) 45 - 54 years	(6) 66 years or older

C. Are you retired? (1) ____ yes; (2) ____ no

D. Please describe your occupation, or what it was when last employed. Please be complete so that we can determine how much it involves the use of science or technical skills. ________________

____

____

E. What is the name of the last school which you attended? ________________

F. Please circle the last year of school which you completed.

Elementary School:	1	2	3	4	5	6	7	8
Secondary School:	9	10	11	12				
College:	13	14	15	16				
Graduate or Professional School	17	18	19	20	21	22	23	24

G. What was the last year of school which your mother/guardian completed? ____

H. What was the last year of school which your father/guardian completed? ____

I. Please circle the number in front of the highest diploma or degree which you have:
(1) Junior High (2) High School (3) Two Year College (4) Bachelor's (5) Master's
(6) Doctorate (7) Other, please describe: ________________

J. Please check below all of the science courses which you completed in school and indicate the number of quarter hours of science courses which you completed at the college level. Multiply semester hours by 1.5 to get quarter hours.

Junior High School

____ Do not know
____ 7th grade science
____ 8th grade science

9-12th Grade

____ Do not know
____ general science
____ earth science
____ biology
____ chemistry
____ physics
____ other, please describe:

____

College: major ________________; minor ________________

Graduate or Professional School:

major ________________; minor ________________

	Number of Quarter Hours		
	0 - 12	13 - 36	37 or more
Biological sciences	____	____	____
Physical sciences	____	____	____
Earth sciences	____	____	____
Engineering courses	____	____	____
Other	____	____	____

Please describe:

____

THIS INFORMATION SHEET SHOULD BE PLACED IN THE STAMPED, RETURN ENVELOPE. AFTER YOU HAVE DONE IT, PLEASE GO TO THE INSTRUCTIONS FOR USING THE SMALL CARDS AND THE SMALL ENVELOPES.